

Dusting is a good example of the futility of trying to put things right. As soon as you dust, the fact of your next dusting has already been established.
George Carlin

METALS

Fresh Track on Indoor Dust

Dust is seldom innocuous. At the very least, it can earn homeowners a reputation for lax housekeeping. More important from a health perspective, it can also exacerbate asthma and allergies. Growing evidence suggests this humble material may pose other health threats caused in part by metals and other potentially toxic substances that hitchhike on core particles.

In traditional risk assessment, one common assumption has been that contaminants in indoor dust are just a dilute version of what's found in the soil outside the building. New evidence from a team of Canadian researchers reveals just the opposite for many metals: indoor dust can be burdened by much higher quantities than in soils outside, and the indoor version can also be more orally bioaccessible (made available to the body through the digestive process). Based on her team's findings, Pat Rasmussen, a research scientist with Health Canada, says the old assumption "is wrong, and can result in a serious underestimate of indoor exposures in residential risk assessments."

This is one of the early results from the Canadian House Dust Study, scheduled to run from 2007 through 2010, for which

Rasmussen is principal investigator. Besides metals, bacteria have been studied in homes in three cities; pesticides, alkylphenols, artificial musks, brominated flame retardants, organotins, parabens, perfluorinated compounds, phthalates, and triclosan also may be studied.

Based on samples from about 1,000 homes in 13 representative cities, the study is expected to set the first scientific baseline for various contaminants in urban Canadian homes. Once all study results are available, Health Canada and the Public Health Agency of Canada, two of the study sponsors, are expected to make recommendations on how best to deal with household dust and its associated contaminants.

For the pilot phase of the metals study, which was published in volume 14, issue 2 (2008) of *Human and Ecological Risk Assessment*, Rasmussen and her colleagues determined the copper, nickel, and zinc contents of archived dust and soil samples from 22 homes in one city. They found not only that the concentration of each metal was far higher in indoor dust than in outdoor soil (9, 3, and 7 times, respectively), but that each metal was much more orally bioaccessible in dust than in soil (13, 8, and 23 times, respectively). In addition, they discovered large differences in the organic and inorganic carbon contents, which were 5

and 10 times higher, respectively, in indoor dust than in soil. Through the use of synchrotron X-ray absorption spectroscopy, the team found that copper was more often bound with organic portions of indoor dust (e.g., sulfides such as cysteine, and possibly acetate and oxalate), while zinc was more often bound with the mineral portions.

"The X-ray analysis is rather novel, and the results informative," says Andrew Turner, an associate professor of environmental sciences at the University of Plymouth, United Kingdom. He is not involved with any segment of the study and says he's unaware of any other study of similar scope.

The team hopes its future studies using the synchrotron and novel applications of technology such as Elementar devices, specialized analytical instruments for examining nonmetallic elements, will help it pin down the specific sources of the indoor metals, whose concentrations tend to vary substantially from house to house in the same neighborhood and even from room to room in the same house for reasons unknown.

Results from earlier studies indicate that many other metals—including lead, cadmium, arsenic, mercury, aluminum, chromium, iron, manganese, and tin—are usually present in indoor dust. Rasmussen is studying the presence in dust of these other elements and is finalizing results for publication.

The mere presence of these metals does not necessarily pose a clear health risk, says Paul Lioy, associate director of the Environmental and Occupational Health Sciences Institute at the University of Medicine & Dentistry of New Jersey. But he says this study, which he did not participate in, adds several nuggets of new information, and he notes there are many indications that this general line of inquiry could prove very important: "Dust is an incredible marker of past exposures to persistent chemicals."

Until more is known about the health effects of house dust, Rasmussen says the best approach for homeowners may be to play it safe and keep dust levels down by vacuuming (a HEPA filter is a good idea but not required, says Rasmussen), damp-wiping surfaces, and removing shoes when entering a house. For situations where the dust is known to be contaminated by a proven toxic source, such as lead paint in older buildings or mercury from a broken compact fluorescent lamp, more specialized cleanup methods are needed. —Bob Weinhold



Indoor dust is more than just a watered-down version of what's found outdoors

Rebecca A. Creative Commons

PERSISTENT ORGANIC POLLUTANTS

Not Finished Yet

Although polychlorinated biphenyls (PCBs) were banned in the United States in 1977, they persist in the environment. These bioaccumulative chemicals can damage the immune, reproductive, endocrine, and nervous systems. When looking for environmental sources of PCBs, scientists generally measure dietary intake from fish, meat, and milk. However, older wood floor finishes that harbor PCBs may present an underestimated route for exposure, finds Ruthann Rudel, a toxicologist at the nonprofit Silent Spring Institute in Newton, Massachusetts.

Animal studies show that PCBs decrease the size of the thymus gland and suppress antibody production and immune responses. People exposed to PCBs can suffer from skin rashes, changes in blood and urine that can indicate liver damage, irregular menstrual cycle, lowered immune response, fatigue, and headache. In children, poor cognitive development is reported. The International Agency for Research on Cancer classifies PCBs as probable human carcinogens.

From 1999 to 2001, Rudel and her colleagues monitored 89 indoor pollutants linked to breast cancer in 120 homes on Cape Cod, where breast cancer rates are among the highest in Massachusetts. As reported 13 September 2003 in *Environmental Science & Technology*, detectable levels of PCBs were found in about a third of the residences, and two houses had exceedingly high levels of PCBs in air and dust.

Five years later, Rudel revisited these two houses to measure air and dust concentrations of the congeners PCB52, PCB105, and PCB153 as well as occupants' blood levels of 10 congeners measured in 1999–2002 as part of the National Health and Nutrition Examination Survey (NHANES). Air and dust levels remained exceptionally high, with dust values ranging from 21 to 190 $\mu\text{g/g}$ —up to 20 times higher than reported in other studies of indoor PCB exposure. Three of the occupants, all of whom had lived in their homes for more than a decade, showed elevated blood levels of PCBs as high as 1,520 ng/g , placing them in the top 5% of people living in the United States. A fourth occupant, who had lived in her house for only six months, had a blood level of 179 ng/g . The study is published as volume 7, article 2 (2008) of the online journal *Environmental Health*.



None of the occupants ate enough fish to account for the high blood levels of PCBs. “We were really stumped,” says Rudel. Then the homeowner with the highest PCB levels recalled that 50 years earlier he had finished his wood floors with high-gloss “Fabulon” varnish. In the 1950s and 1960s, Fabulon was a popular coating sold nationwide to give floors a “bowling-alley shine.” A now-discontinued reference manual, *Clinical Toxicology of Commercial Products*, confirmed that Fabulon contained PCBs between 1950 and 1969. Before being banned, PCBs were not only added to varnishes but also to caulk, paint, linoleum, and ceiling tiles, where they served as stabilizers, sealants, and adhesives.

The same homeowner had sanded one of his floors just before Rudel returned to collect samples for the latest study. However, the floors in the other house had not been refinished in years. Rudel suspects, but has not confirmed, that the floors may be giving off PCBs, with sanding releasing even higher levels of dust packed with PCBs. She hopes to conduct further research—such as whether a peak time for exposure occurs when sanding off PCB-laced finishes, or whether carpets later laid over finished wood floors limit airborne exposure—that might shed light on safer ways to remove PCBs.

What can homeowners do, pending further information? “I’m not happy about how little I can tell people,” Rudel admits. Foremost, she advises not sanding old wood floors. PCB analysis is expensive, and Rudel knows of no laboratories that service homeowners. However, some floor-finishing businesses offer a dustless sanding process that pumps toxic dust into outdoor tanks.

ehpnet | by Erin E. Dooley

Design for the Environment Partnerships

<http://www.epa.gov/oppt/dfe/pubs/projects/index.htm>

The U.S. Environmental Protection Agency (EPA) Design for the Environment Program works with various industries to minimize the use of toxic chemicals and identify suitable replacement for such ingredients. As part of this program, the EPA convenes partnerships around specific industries to evaluate the health considerations, performance, and costs of traditional and alternative technologies, materials, and processes used in those industries. Two of these partnerships, described on the program’s Partnership Projects website, seek to identify environmentally sound alternatives to flame retardants currently in use.

Each partnership’s website provides an overview of the partnership and the chemicals it focuses on. The Flame Retardants in Printed Circuit Boards Partnership consists of members from government, the computer and chemical industries, and environmental advocacy organizations. This partnership is just beginning its third year and, according to the website, plans this spring to publish a report on its findings to date.

The Furniture Flame Retardancy Partnership began in 2003 and convenes government, the furniture and chemical industries, and environmental groups. Its site describes current regulatory actions in the area of flame retardancy and highlights its latest publication, *Environmental Profiles of Chemical Flame-Retardant Alternatives for Low-Density Polyurethane Foam*. This two-volume overview of alternatives to the compound pentaBDE includes detailed hazard assessments of more than 10 chemicals believed to be viable substitutes.

The Furniture Partnership page offers background information on green chemistry and green engineering as well as a chart of international and national milestones relevant to the decision to ban penta-BDE. Visitors can also download a pamphlet on environmentally preferable methods for achieving furniture fire safety standards, a fact sheet on flame-retardant alternatives for foam used for furniture manufacturing, and the Environmental Profiles report.

“Rudel certainly found an unrecognized source of PCBs that underscores the importance of inhalation as an underappreciated but important source of exposure,” says David Carpenter, a public health physician at the University at Albany, State University of New York. The results add to a growing body of awareness that building materials can be a significant source of PCBs indoors. “The assumption that PCBs stay put simply is not true,” Carpenter says.

—Carol Potera

DIET AND NUTRITION

Eye on Iodine

Before the 1924 advent of salt iodization, millions of Americans suffered from iodine deficiency. Now, eight decades after salt iodization virtually eliminated iodine deficiency in the United States, intake of this essential mineral has once again declined enough for some scientists to recommend new measures to ensure Americans get sufficient amounts.

The thyroid gland needs iodine in order to produce thyroid hormone, which regulates body metabolism, growth, and development. Iodine is especially important during pregnancy and lactation for infants' neurological development. Maternal iodine deficiency is associated with mental retardation and cretinism in the newborn.

In the first National Health and Nutrition Examination Survey (NHANES I), conducted in the early 1970s, only 1% of pregnant women examined had urinary iodine levels below 50 µg/L (although this level suggests moderate deficiency, it is impossible to ascertain deficiency from a single urine sample). By the time of the 2000–2001 NHANES, 7.3% of pregnant women had urinary iodine values below 50 µg/L.

Where did all the iodine go? According to the Virginia-based Salt Institute, only 20% of food salt is iodized today, and most of that is sold at grocery stores. Salt iodization is voluntary in the United States, and Morton Salt, president of the Salt Institute, says most food processors and restaurants never adopted iodized salt because it wasn't required. As Americans have embraced processed foods and restaurant meals, non-iodized salt has supplanted the iodized type in many people's diets. Saltin says his organization has publicly asked the food and restaurant industries for broader iodization. Iodine was also used at one time in dairy products and bread, but has been replaced with more effective alternatives.

Purnendu Dasgupta, a biochemist at The University of Texas at Arlington, published research in the 15 February 2008 issue of *Environmental Science & Technology* showing that 53% of iodized salt samples tested had lower iodine levels than recommended by the U.S. Food and

Drug Administration. The study also revealed that exposure to high humidity diminishes iodine in salt.

The possibility of asymptomatic iodine deficiency during pregnancy is raising concern. "I think it's quite likely we've had subtle neurological deficiencies in babies born in the U.S. [to mothers with mild iodine deficiencies]," says Elizabeth Pearce, an assistant professor of medicine at Boston University School of Medicine. To protect developing fetuses, Pearce and other scientists are calling on the government to boost Americans' iodine intake. "I wouldn't endorse greater salt intake," says thyroid specialist Robert Utiger of Harvard Medical School, referring to salt's association with hypertension, heart disease, and stroke. "But the iodine content of salt ought to be increased."

Since 1994, the World Health Organization has recommended universal salt iodization to combat deficiency. Says Satin, "One approach would be to adopt the strategy being employed in New Zealand. They are taking measured steps in specific food categories and can keep adding [iodization to] additional food categories as monitoring dictates." Kevin Sullivan, an associate professor of epidemiology at Emory University in Atlanta, says that if food processors adopt iodized salt we should closely monitor iodine levels through ongoing NHANES studies to see if iodization recommendations need to be adjusted.

Another approach is to require iodine in all prenatal vitamins. Although the American Thyroid Association has promoted such a measure since 2006, Pearce says only an estimated 50% of prenatal vitamins contain iodine.

Says Dasgupta: "Some believe that iodine deficiency is a disease of the past that was 'cured' in the 1930s with the iodization practices. This leads to the thought today that iodization is not needed because it was cured, but the fact is that it is a deficiency disorder, not a disease." —Cynthia Washam

The Beat | by Erin E. Dooley

Navajo Fight Uranium Comeback

In 2005 the Navajo nation banned uranium mining and milling on its lands because of increases in lung cancer and other chronic diseases in miners and residents living near piles of mine waste. Now, because of soaring uranium prices and the challenge to find cleaner domestic sources of energy, mining companies are seeking state permits to mine the estimated 500 million pounds of uranium reserves located in and near the Navajo lands.



In late 2007 the Navajo nation asked Congress for a moratorium on uranium mining on Indian lands despite pending state legislation that would require mining companies to set aside a small percentage of their profits as a "legacy fund" to clean up existing contaminated sites and the promise from the companies to use more sustainable mining methods.

New Lead Paint Rule

On 31 March 2008, the EPA issued long-awaited new regulations on reducing children's exposure to lead paint during renovations and repairs of buildings constructed before 1978. The regulations will go into effect in April 2010, at which time contractors and maintenance professionals working in pre-1978 housing, child-care facilities, and schools must be trained and certified in lead-safe practices. The EPA is initiating an education and outreach campaign to alert the industry to these new requirements. Despite industry estimates that the new rules will drive up renovation costs, several senators have announced their plans to introduce more stringent legislation that would reduce loopholes in the current rules and require more testing to ensure vulnerable populations are thoroughly protected.

Race Without a Trace

In support of the ongoing international trend toward making sporting events more environmentally friendly, the North Carolina-based *Endurance Magazine* has launched the "Race Without a Trace" initiative to minimize the waste and carbon emissions generated by endurance



events. The initiative focuses on producing events with a carbon-neutral strategy by purchasing carbon offsets, reducing the amounts of paper used for marketing and distribution at races, encouraging the use of eco-friendly portable toilets at events, and composting leftover food and paper. The next level of effort includes finding

DRINKING WATER QUALITY

Lead Particles on Tap

Lead exposure is a serious concern for children's health. Lead impairs children's brain development, and many scientists believe no dose is safe. High levels of lead in the paint used on children's toys resulted in numerous toy recalls in 2007. But some school drinking water may also expose children to high levels of lead, according to environmental engineer Marc Edwards of Virginia Polytechnic Institute and State University.

Children's toys and jewelry are recalled if the accessible lead dose—the amount expected to actually make its way into a child—exceeds 175 µg. In an eight-ounce glass of water, 175 µg lead converts to 700 ppb, according to Edwards, who notes that levels this high have been reported in school drinking fountains in Washington, DC; Seattle, Washington; and communities in Virginia and Massachusetts.

In 2007 more than 10% of the Washington, DC, schools Edwards tested had at least one fountain with lead levels greater than 700 ppb. He says the most contaminated sample contained 20,000 ppb lead, equivalent to eating 14 dime-sized pieces of paint containing more than 16 times the Consumer Product Safety Commission limit for lead in paint. Some of this lead is dissolved in the water, but much of it remains in particulate form, originating primarily from old lead solder. Edwards presented these findings at “20 Years of Success and a Vision for the Future,” a December 2007 meeting cosponsored by the NIEHS Superfund Basic Research Program.

Elevated blood lead levels in children from North Carolina and Washington, DC, have been traced by local public health authorities back to particles of solder in drinking water. In each case a change in water treatment appears to have exacerbated corrosion of water pipes, releasing more particles from solder into the water. Water filters that are attached to the faucet remove both dissolved and particulate lead, but pitcher-type filters do not, according to NSF International, which certifies water filters.

Scientists have considered solder to be a minor source of lead in drinking water because they believed that, over time, mineral films form barriers between the water and the solder. “In fact, just like lead paint ages and creates hazards as it degrades, so too does lead solder,” Edwards says. The presence of particles changes the importance of drinking water as a lead source, says Ralph Scott, community projects director of the Alliance for Healthy Homes, an advocacy group. “In most cases we have assumed and still assume that water is a small part of the problem compared to paint,” he says. “But now we are looking at a dimension of the water problem never considered before.”

Lead, covered by the 1991 Lead and Copper Rule, is one of the few drinking water contaminants monitored at the household tap. However, Edwards says that current regulations may miss tap water lead for a number of reasons. These include the current testing method, which he believes does not adequately measure particulate lead. Also, regulations require 90% of tested dwellings to meet the regulatory requirements but say nothing about the upper 10% of dwellings, which can have very high lead levels. Edwards and colleagues described these concerns in the June 2007 *Journal of the American Water Works Association*.

But EPA spokesperson Sakeba Carter-Jenkins says the agency has seen no data indicating its current methods miss particulate lead. “If EPA does receive data showing that these procedures need modification, it can be considered as part of the long-term revisions to the Lead and Copper Rule,” says Carter-Jenkins.

The EPA plans to begin reviewing the Lead and Copper Rule next year. Last year, the agency changed the rule so that water providers must report to the state before changing their water treatment regimens. This will allow for more timely monitoring of any changes in water quality at the tap, says Martha Keating, outreach coordinator with the Children's Environmental Health Initiative at Duke University. —Rebecca Renner

alternative energy sources for finish-line electronics and minimizing the shipping required for race day materials and goods.

Nanofood on Research Menu

For the past few years, the food industry has spent millions of dollars on nanotechnology research and development, but there has been little government oversight concerning the safety and regulation of “nanofoods” (foods produced with or packaged using nanomaterials). The authors of a report in the March 2008 issue of *Food Additives and Contaminants* say the uncertainties posed by the lack of data

on the health effects of nanofoods warrant action at the regulatory and research levels, as large segments of the population are likely to consume such products without knowing it. *Out of the Laboratory and on to Our Plates*, an April 2008 report by Friends of the Earth, further recommends that “nano-” be redefined to include particles up to 300 nm in size, which may also pose health risks.

Key to Reducing CO₂?

Each year, buildings release 35% of the total CO₂ emitted in North America. In March 2008, the trilateral Commission for Environmental Cooperation released *Green Building in North America: Opportunities and Challenges*, which prescribes green design, construction, renovation, and operation as ways to reduce emissions more significantly, cheaply, and quickly than other available means. Among the report's recommendations are that the North American governments establish joint green building guidelines and bolster research and development efforts in this area.

New Findings on Gulf War Illness

Increasing evidence suggests that chronic multisymptom illness in Persian Gulf War



veterans can be partly explained by exposure to organophosphate and carbamate acetylcholinesterase inhibitors (AChEis) in the nerve agent sarin, anti-nerve gas pills, and pesticides used to control vectorborne diseases. A review published in the 18 March 2008 issue of the *Proceedings of the National Academy of Sciences* demonstrates that such exposures may be linked to multisymptom health problems in 25–33% of returning Gulf War veterans. The author also presents evidence that genetics may play a role in the illness—some individuals have lower activity of enzymes that detoxify AChEis, thereby intensifying their susceptibility to the chemicals' effects.



Left to right: Pali Rao/Sockphoto, Dieter Endlicher/APWorldwide